

IEEE P802.15 Working Group for Wireless Personal Area Networks

Update on the MAC Coexistence Modeling Effort

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NIST

Outline

- Objectives
- Part I: Progress Report
 - Additional Features/ Functionality
 - MAC/ PHY Interface
 - Example of BER Modeling
- Part II: Case Study
 - Traffic Model
 - Simulation Results

Objectives

- Give a progress update on the MAC modeling effort.
- Demonstrate the model capabilities and experiment with different BER distributions.

Progress Report

Basic Model 3/00

- Connection mode
- Round Robin master scheduler
- Asynchronous Connection-Less (ACL) Link
- Frequency Hopping

Addionnal Features 5/00

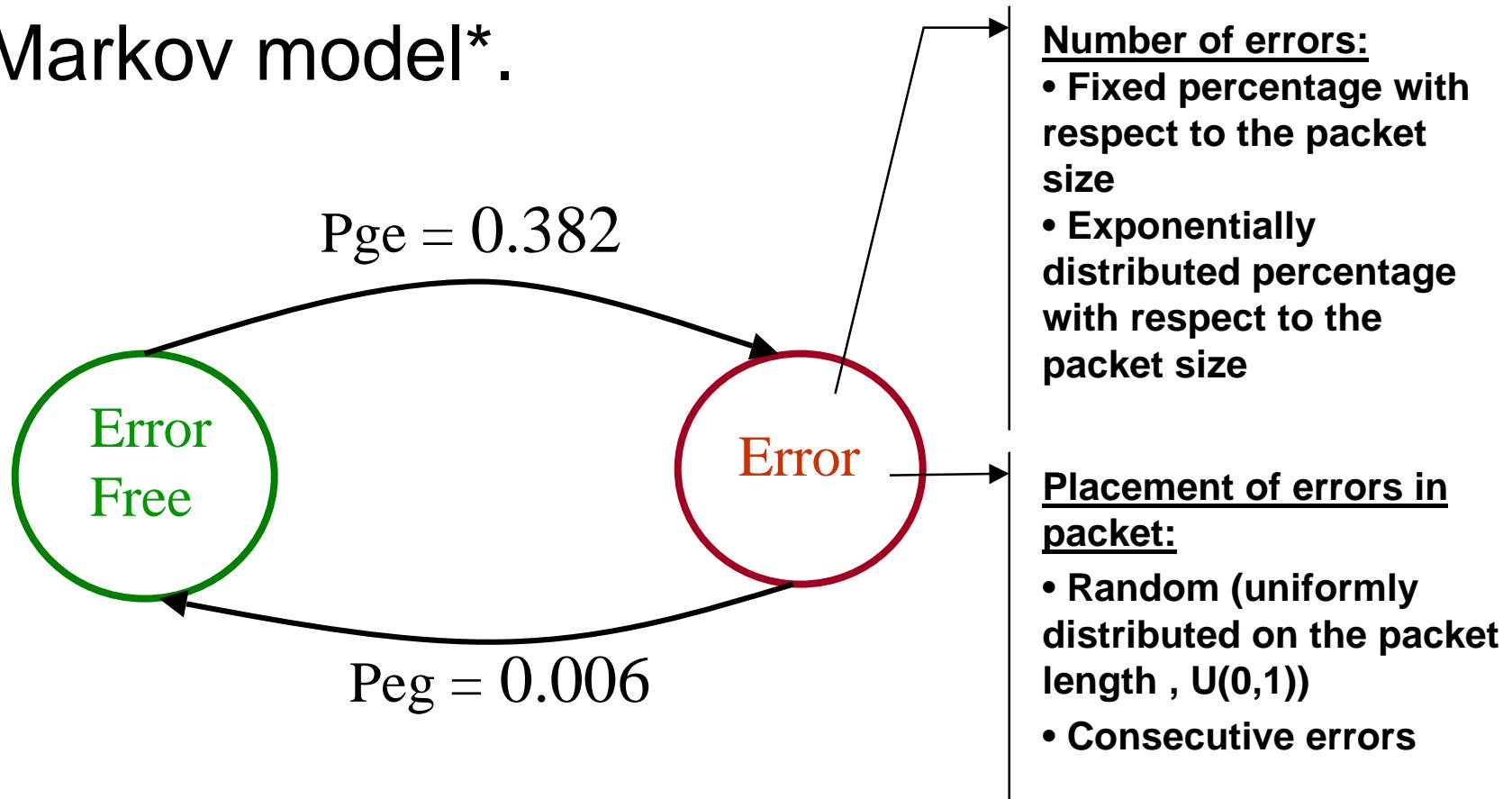
- L2CAP segmentation and reassembly
- Polling
- BER modeling
- FEC, CRC and HEC
- Retransmission (ARQ and SEQN)
- Statistics collection

MAC / PHY Interface

- 1) A dynamic interface includes 3 steps:
 - creation of a bit stream
 - function call to PHY model and execution of MATLAB or “C” routine.
 - regeneration of Baseband frame (with errors).
- 2) A parametric interface captures the characteristics of the BER distribution:
 - number of errors in a packet
 - location of errors in a packet

Example of BER Modeling

Parametric interface based on a two-state Markov model*.

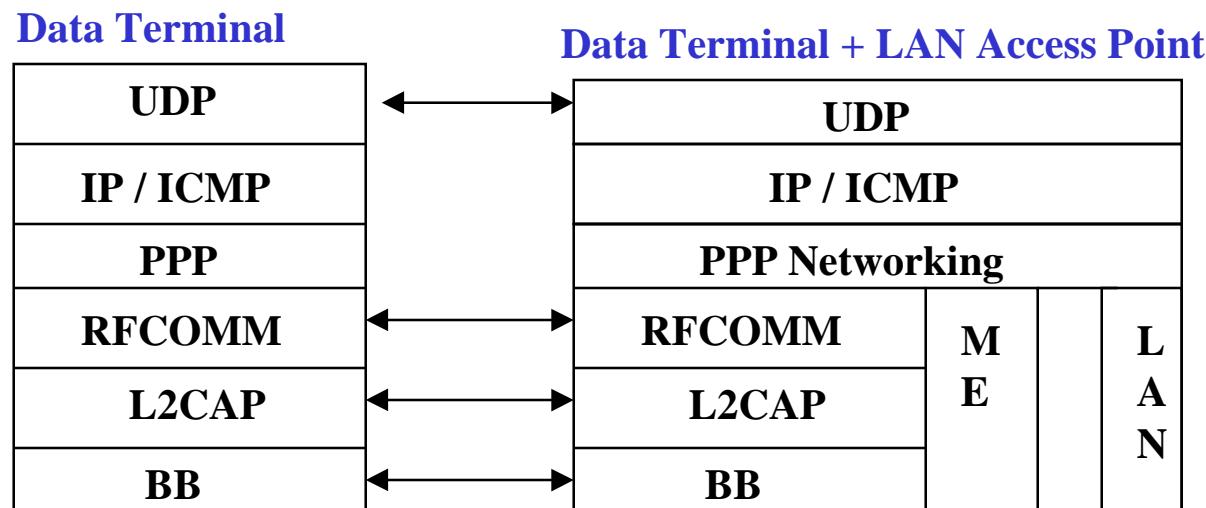


* G. T. Nguyen, R. H. Katz, M. Satyanarayanan, B. Noble, "A Trace-based approach for modeling wireless channel behavior," Proceedings of the Winter Simulation Conference, pp. 597-604, Orlando Florida, December 1996.

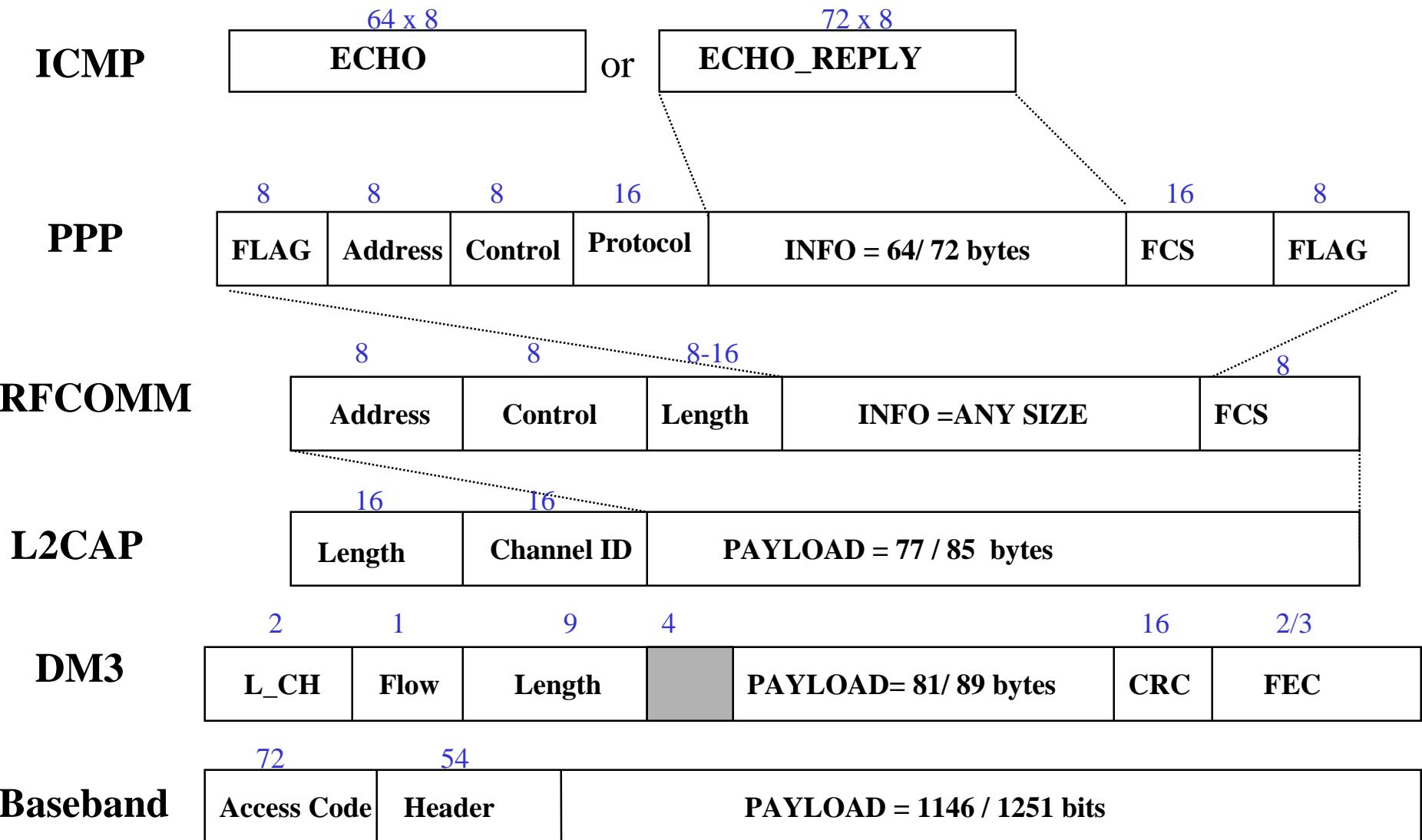
Case Study

Traffic Model: Connectionless Application

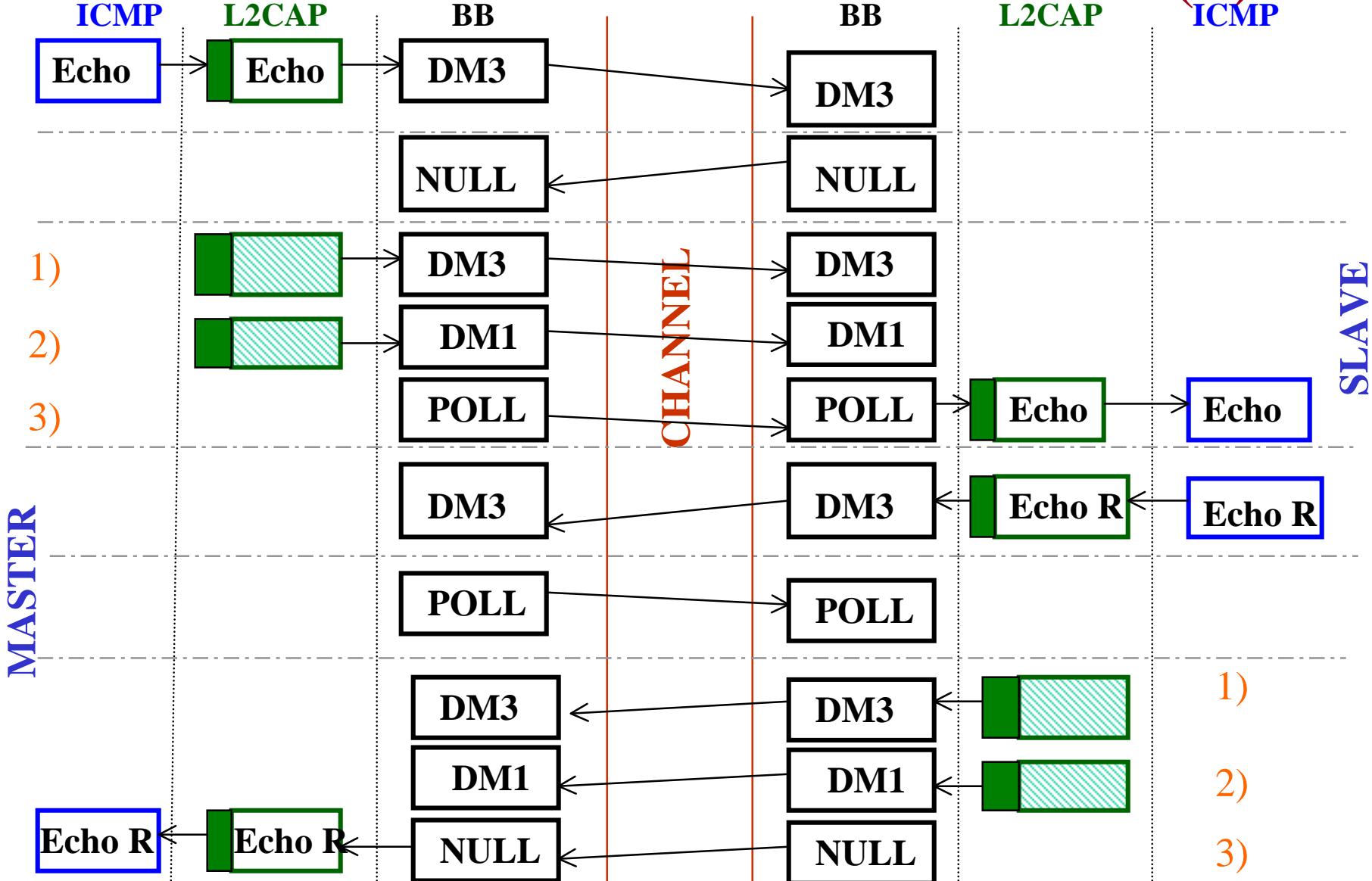
- Simple ICMP application (i.e ping) is preferred over TCP because it has no error recovery and connection establishment mechanisms.
- LAN Access Profile, Bluetooth Spec. V1.0B
- PC to PC connection using LAN access.

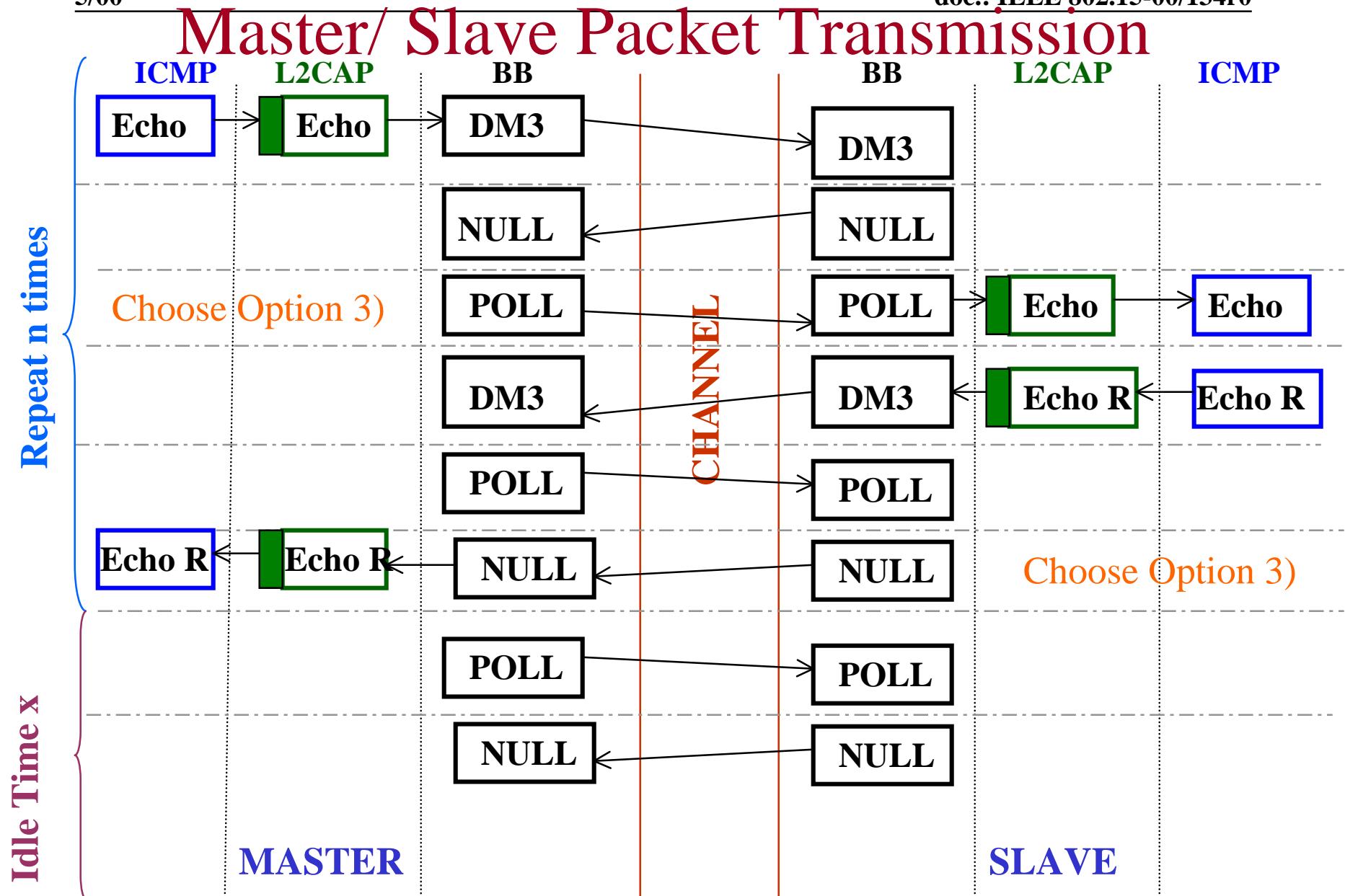


Packet Encapsulation



Master/ Slave Packet Transmission (1)



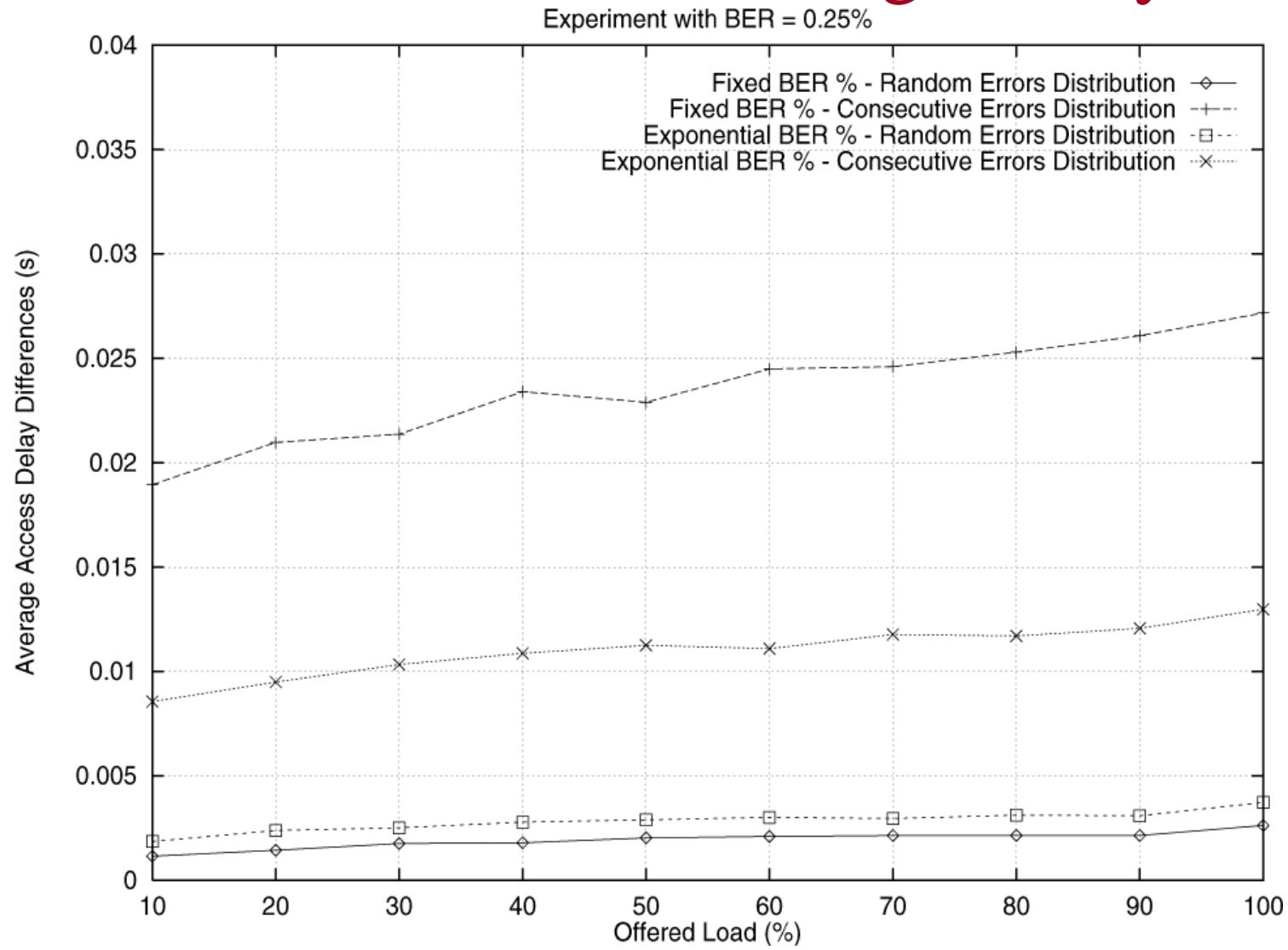


Simulation Parameters

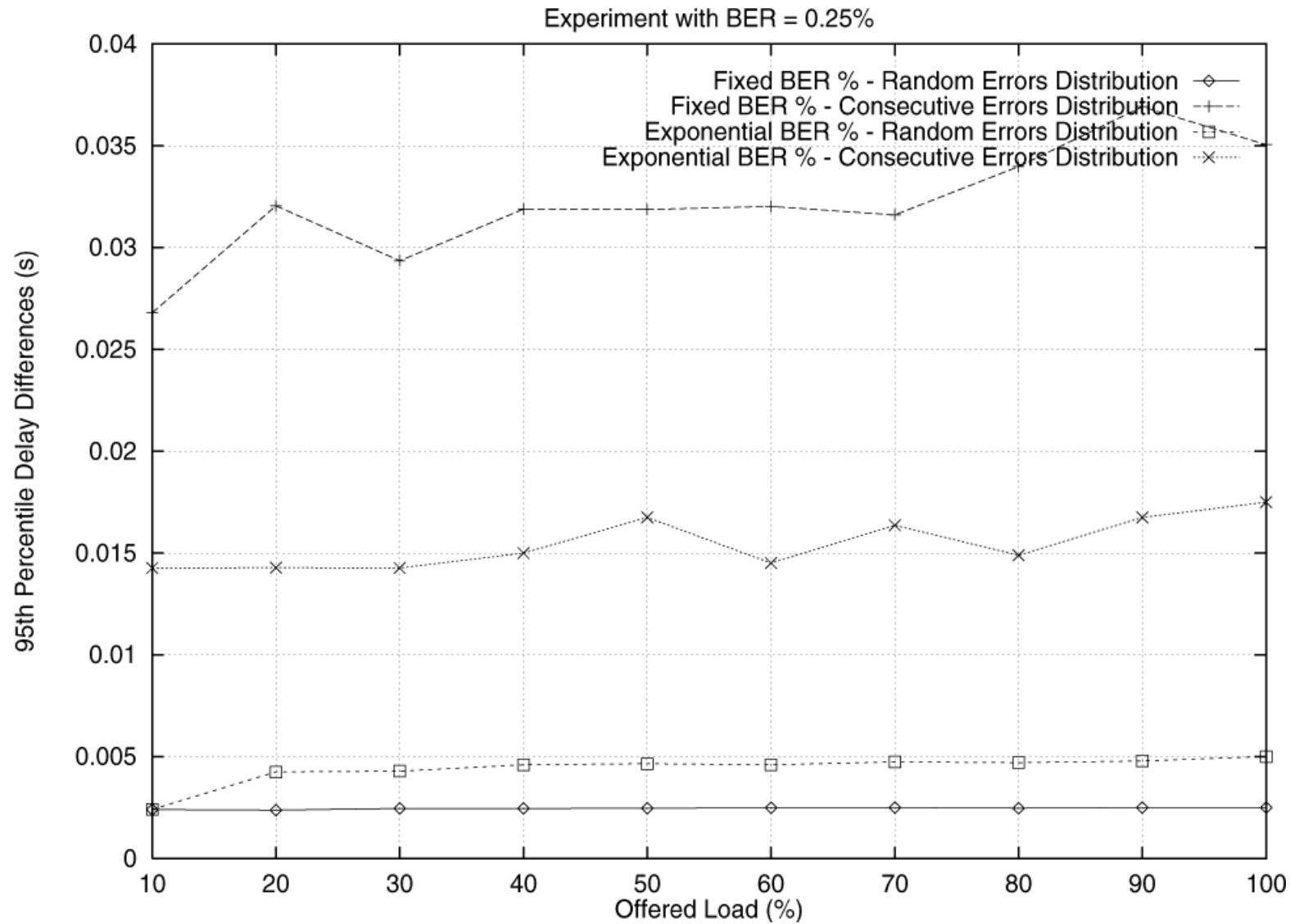
- Number of devices in a piconet:
 - 2 devices (Master/ Slave).
- Distance between devices: 10m.
- Traffic: ICMP application:

$n = 2$ and $x = 0.00625 * n * (1/\text{Load} - 1)$
where Load is % of max throughput.
- 100% Throughput = 464160 bits/s.
- Measurement are performed at:
 - L2CAP for access delay, throughput, and goodput.
 - Baseband for packet loss

BER = 0.25% , Average Delay

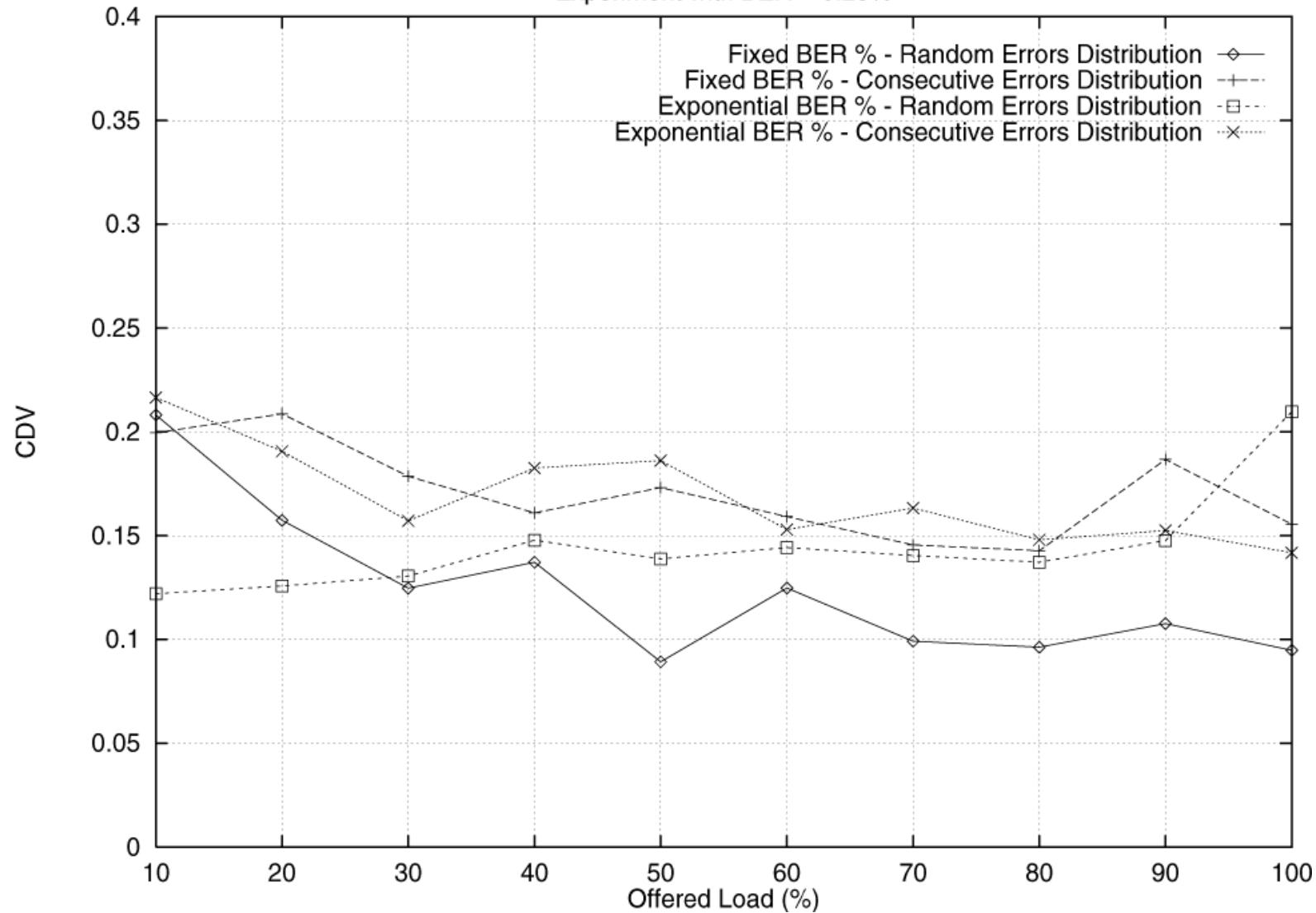


BER = 0.25% , Delay Percentiles



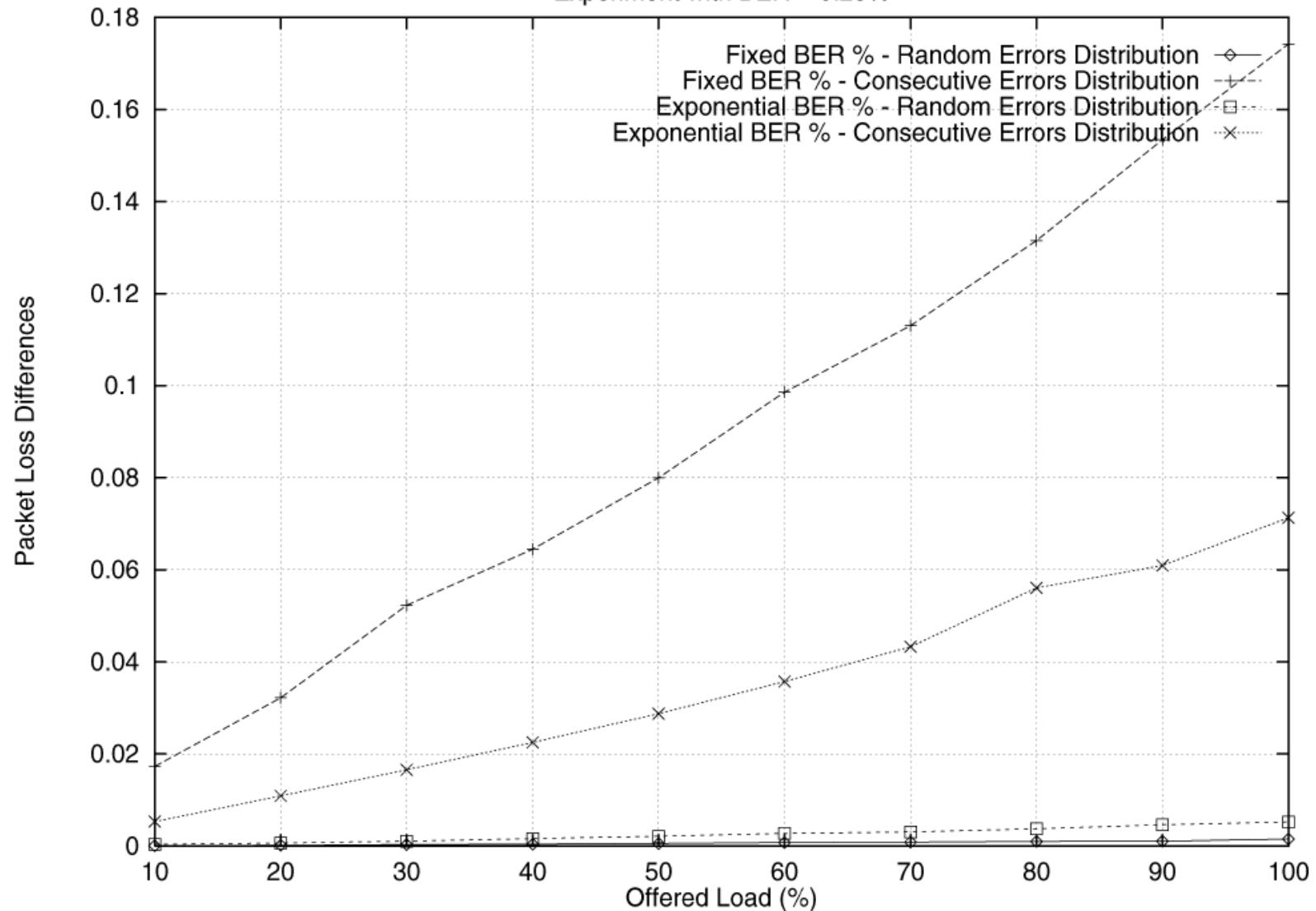
BER = 0.25%, Coefficient of Delay Variance

Experiment with BER = 0.25%



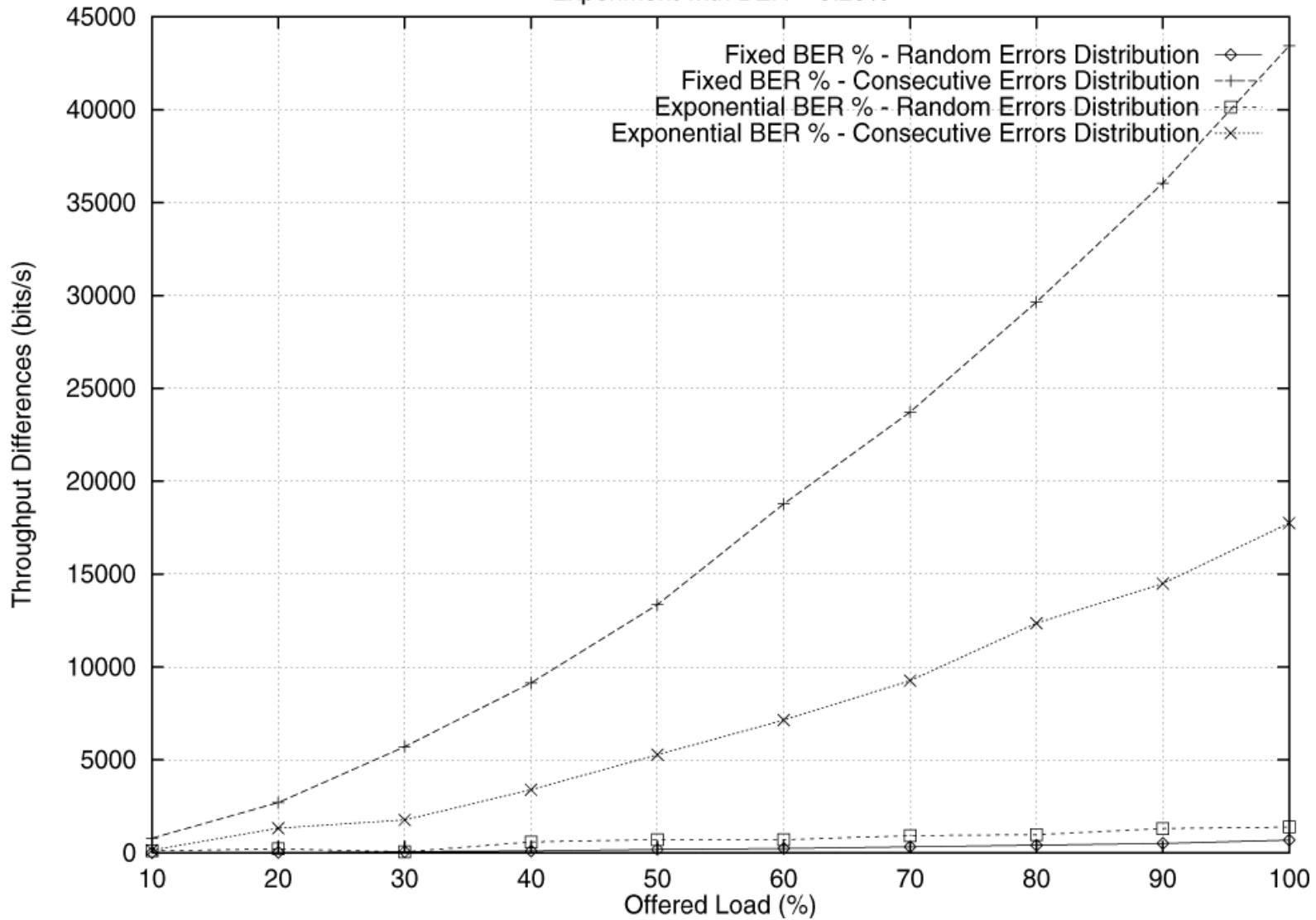
BER = 0.25% , Packet Loss

Experiment with BER = 0.25%



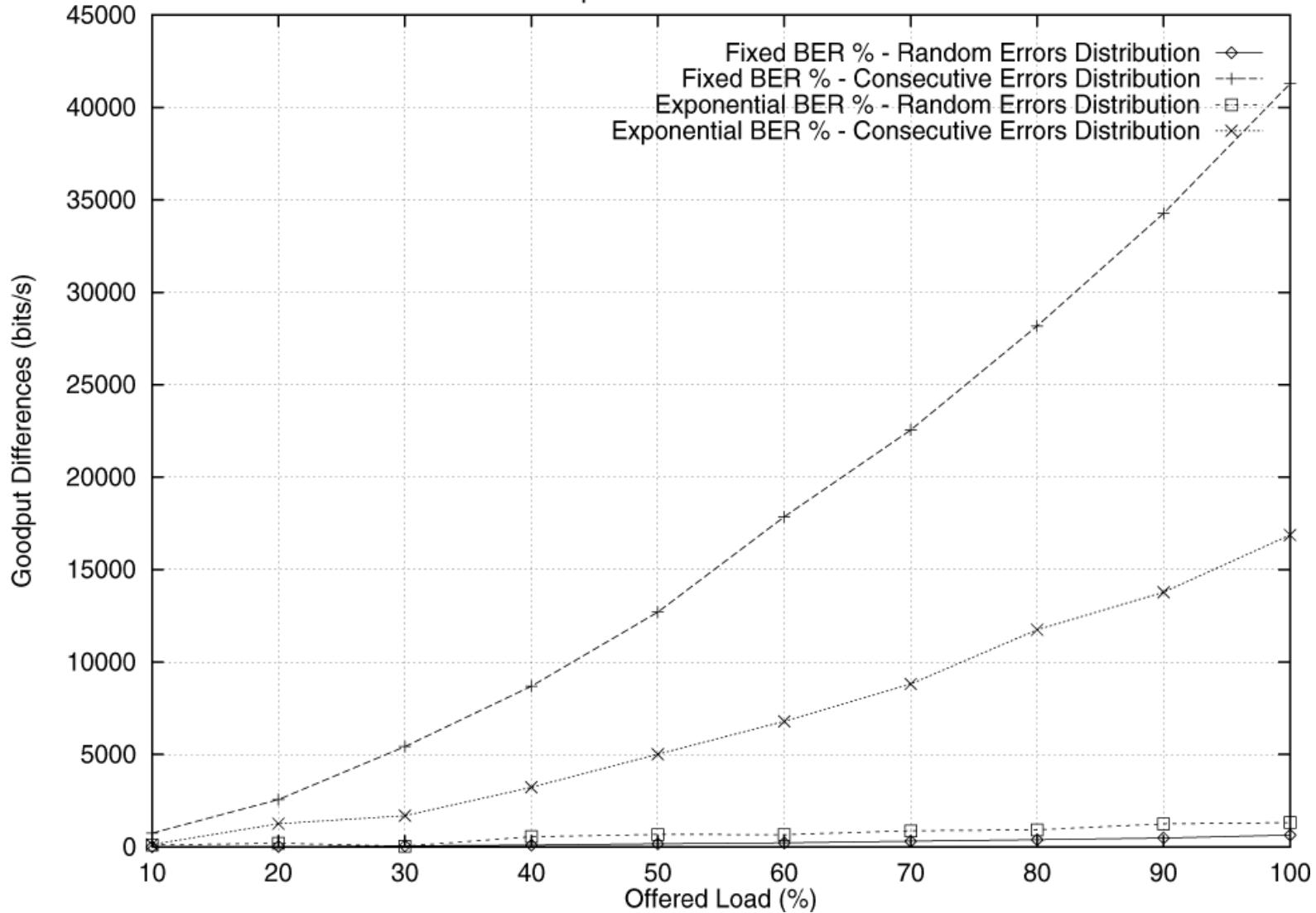
BER = 0.25% , Throughput

Experiment with BER = 0.25%



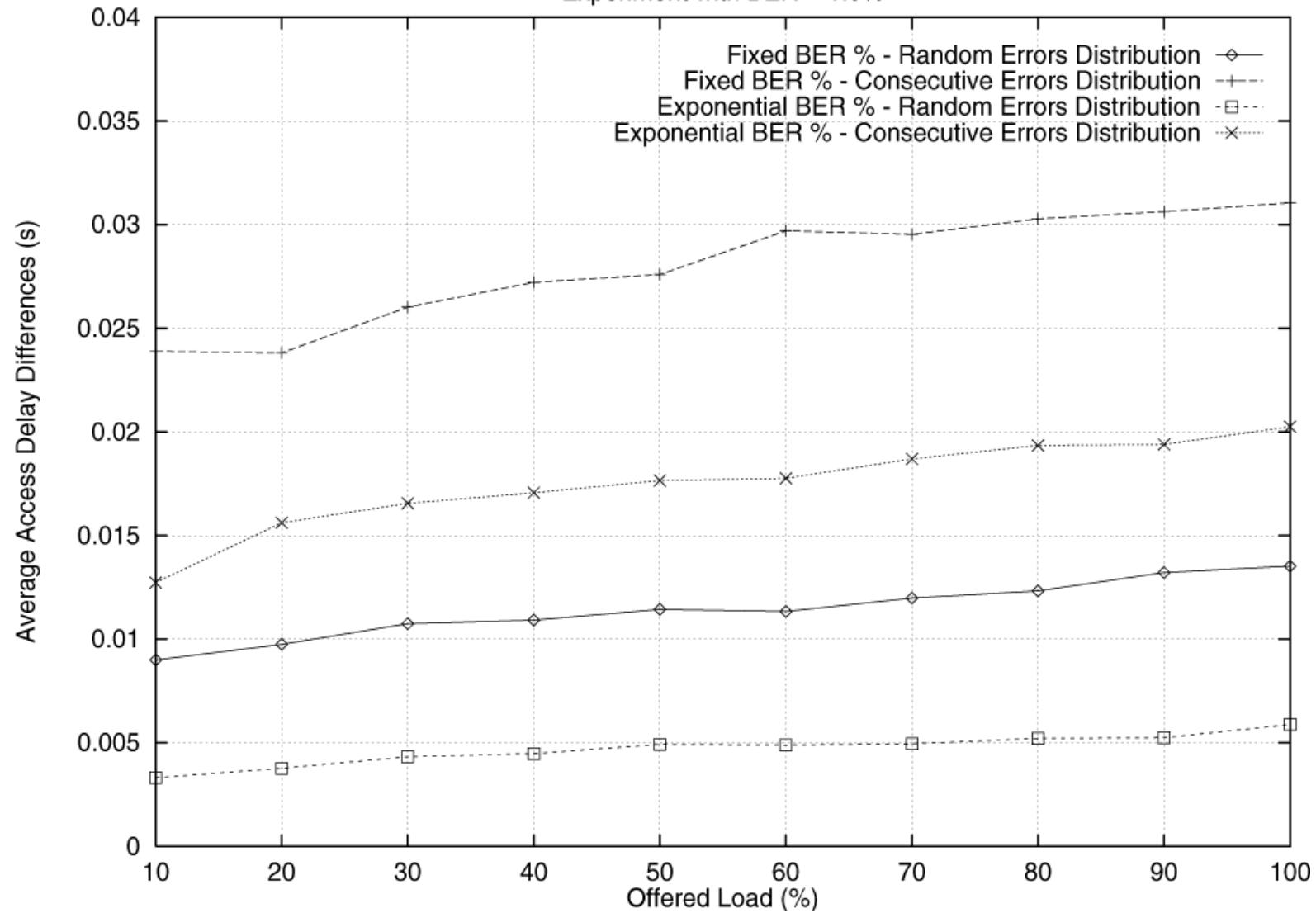
BER = 0.25%, Goodput

Experiment with BER = 0.25%



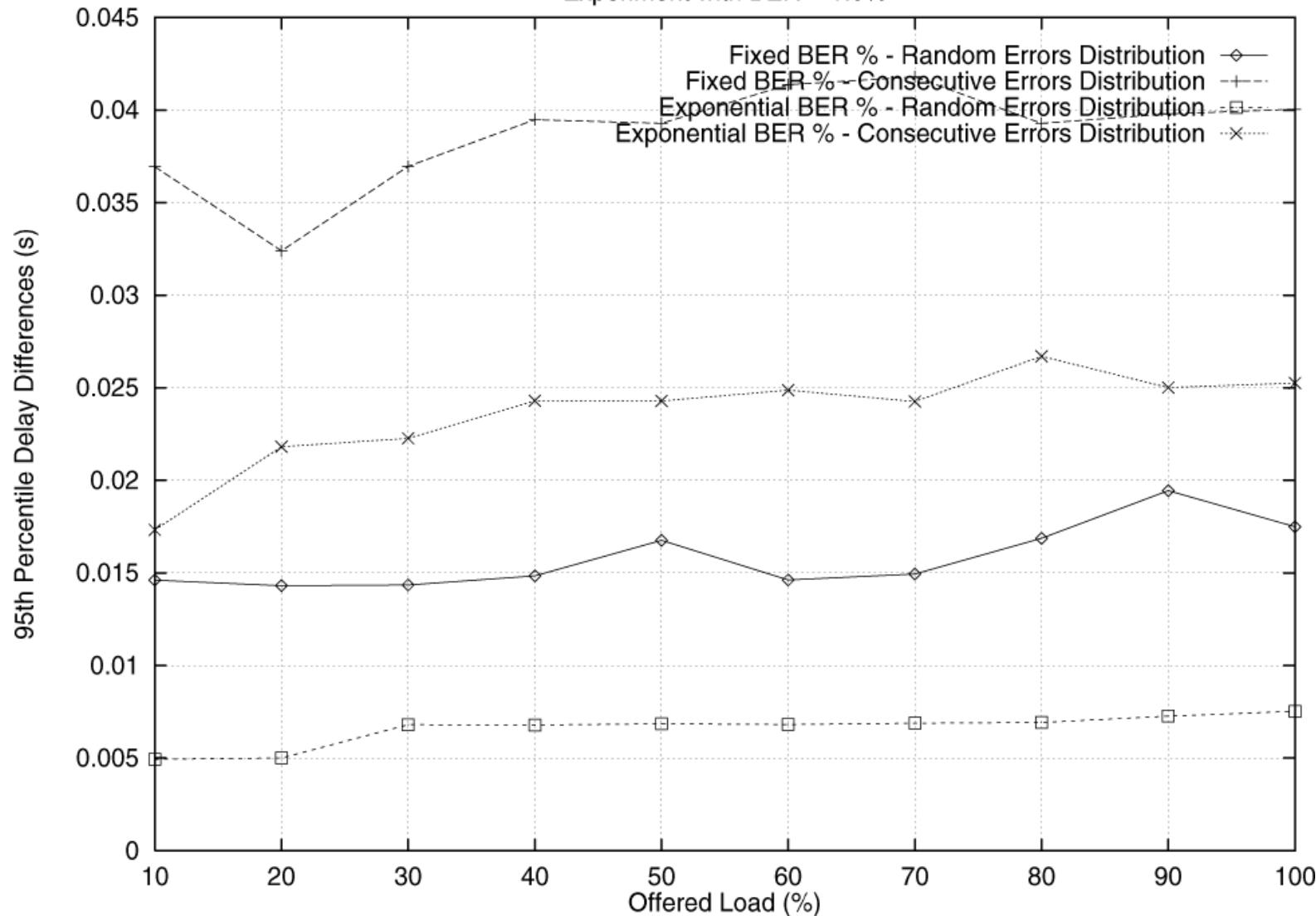
BER = 1%, Average Delay

Experiment with BER = 1.0%



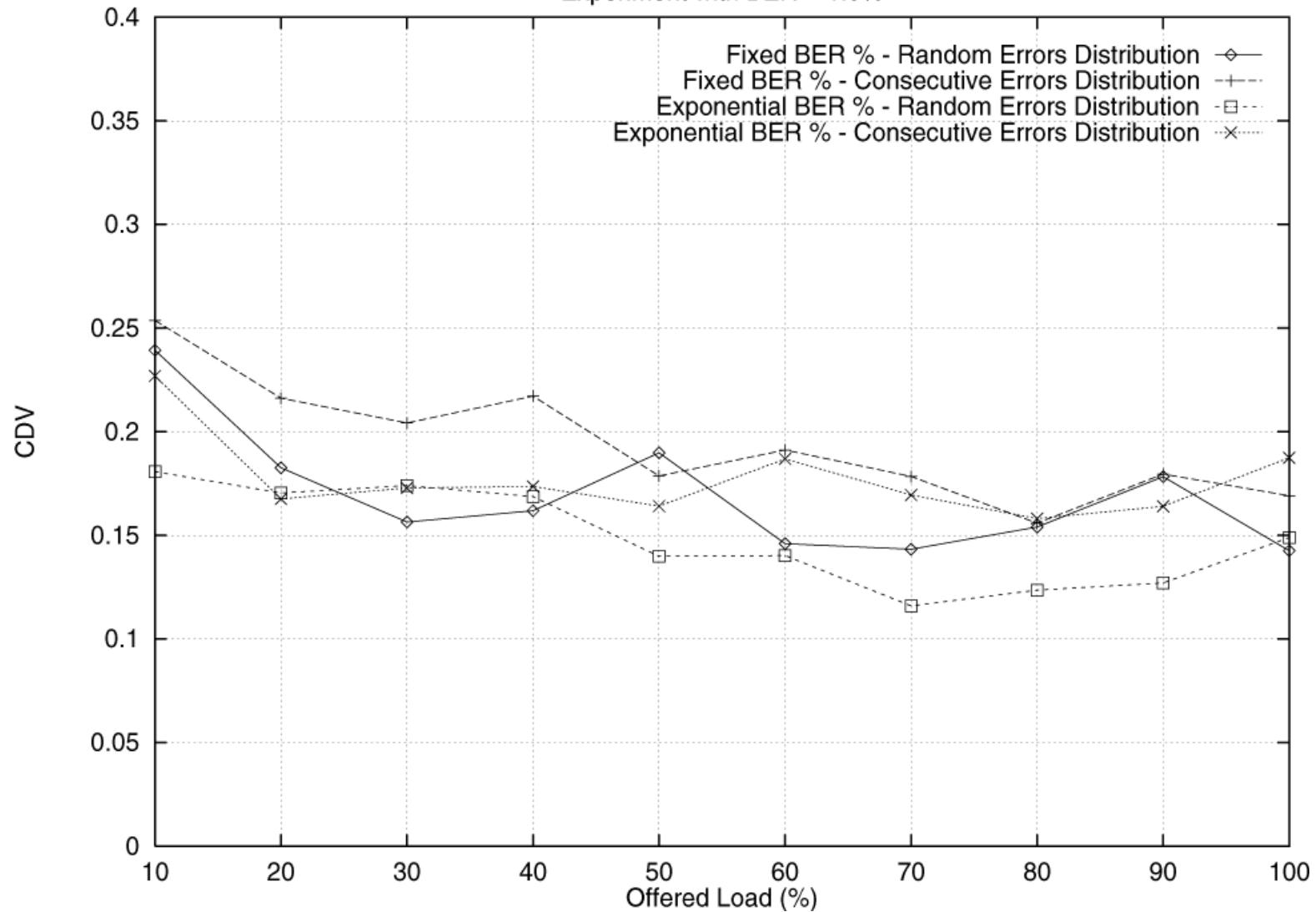
BER = 1% , Delay Percentiles

Experiment with BER = 1.0%



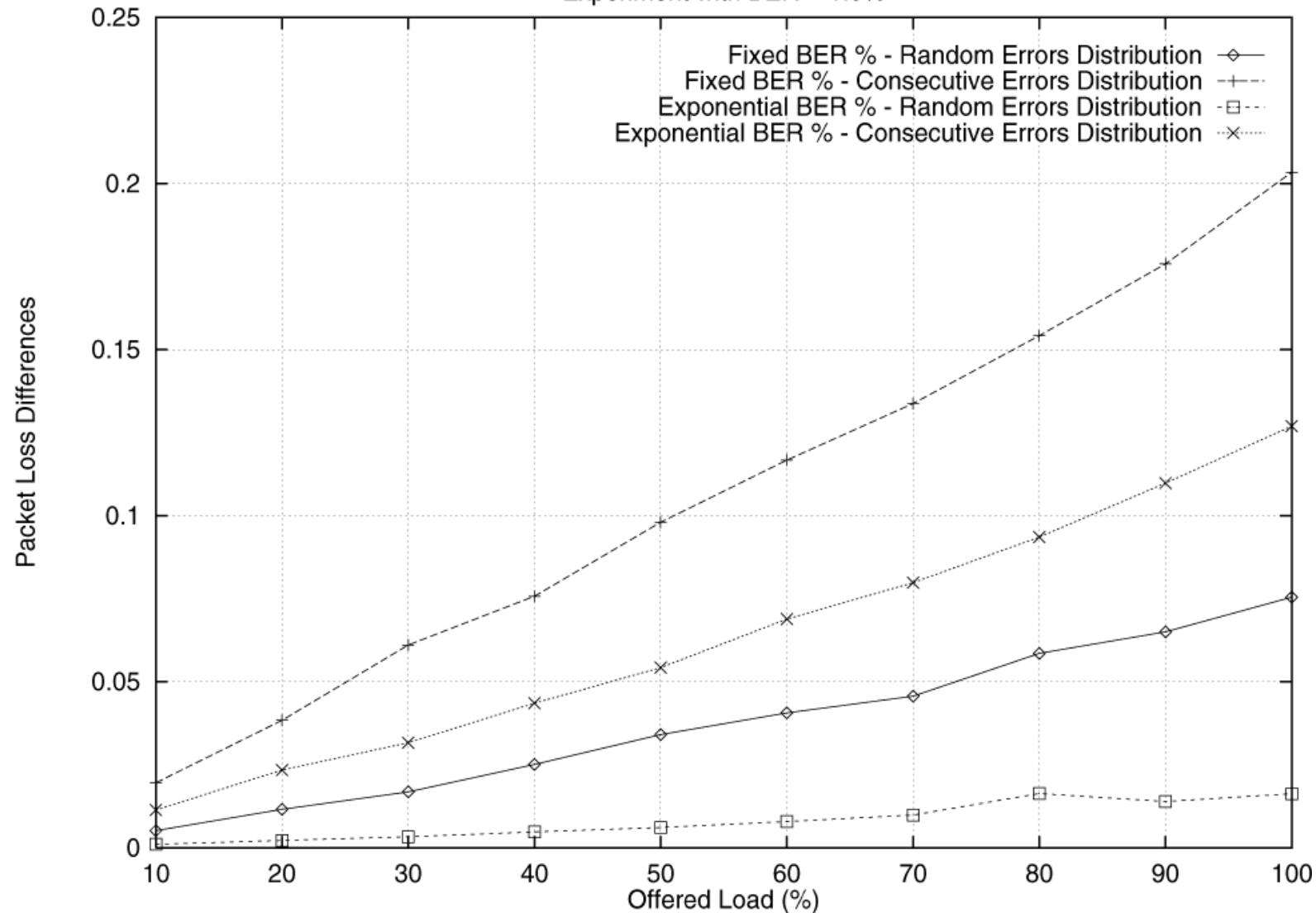
BER = 1%, Coefficient of Delay Variance

Experiment with BER = 1.0%



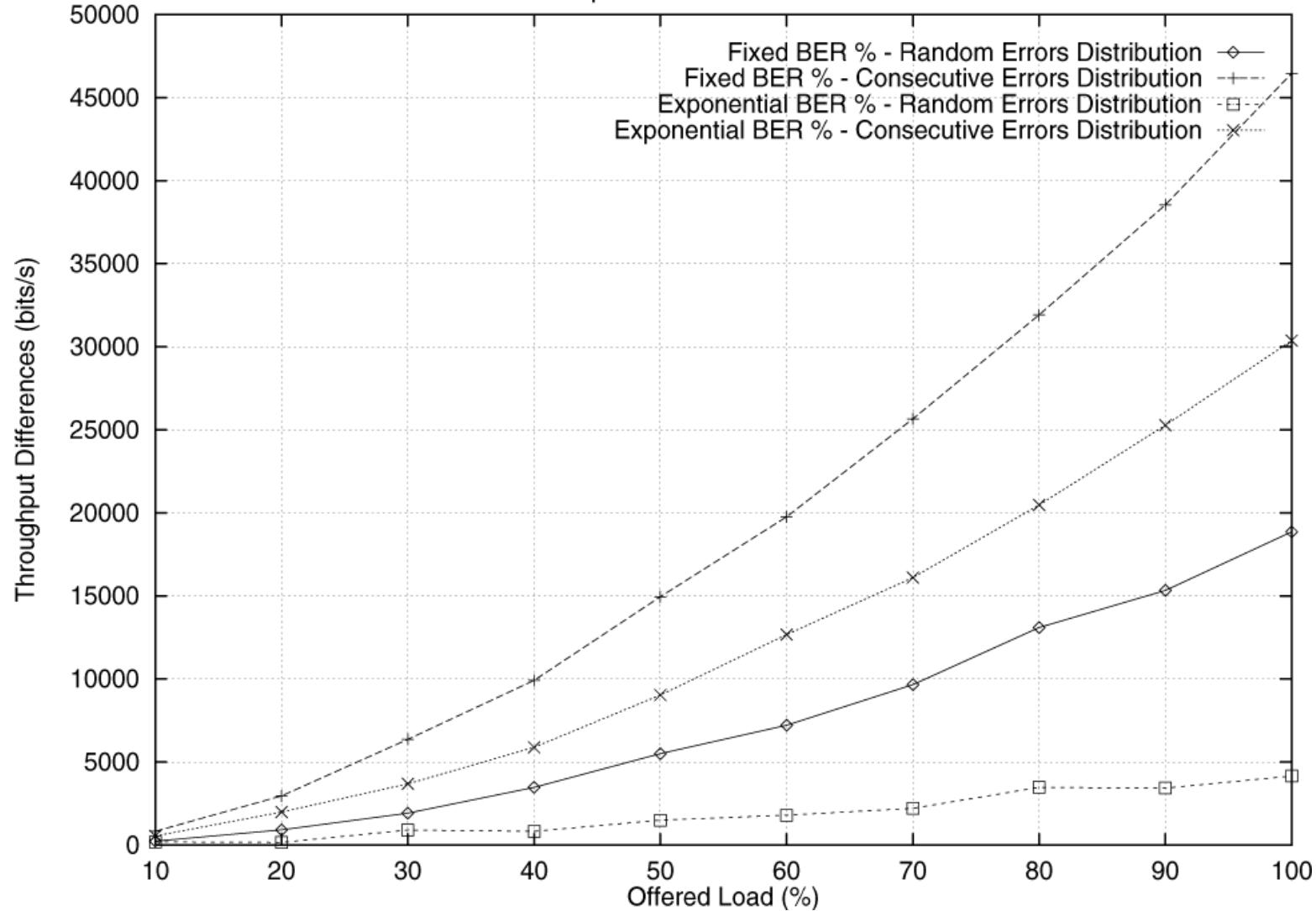
BER = 1% , Packet Loss

Experiment with BER = 1.0%



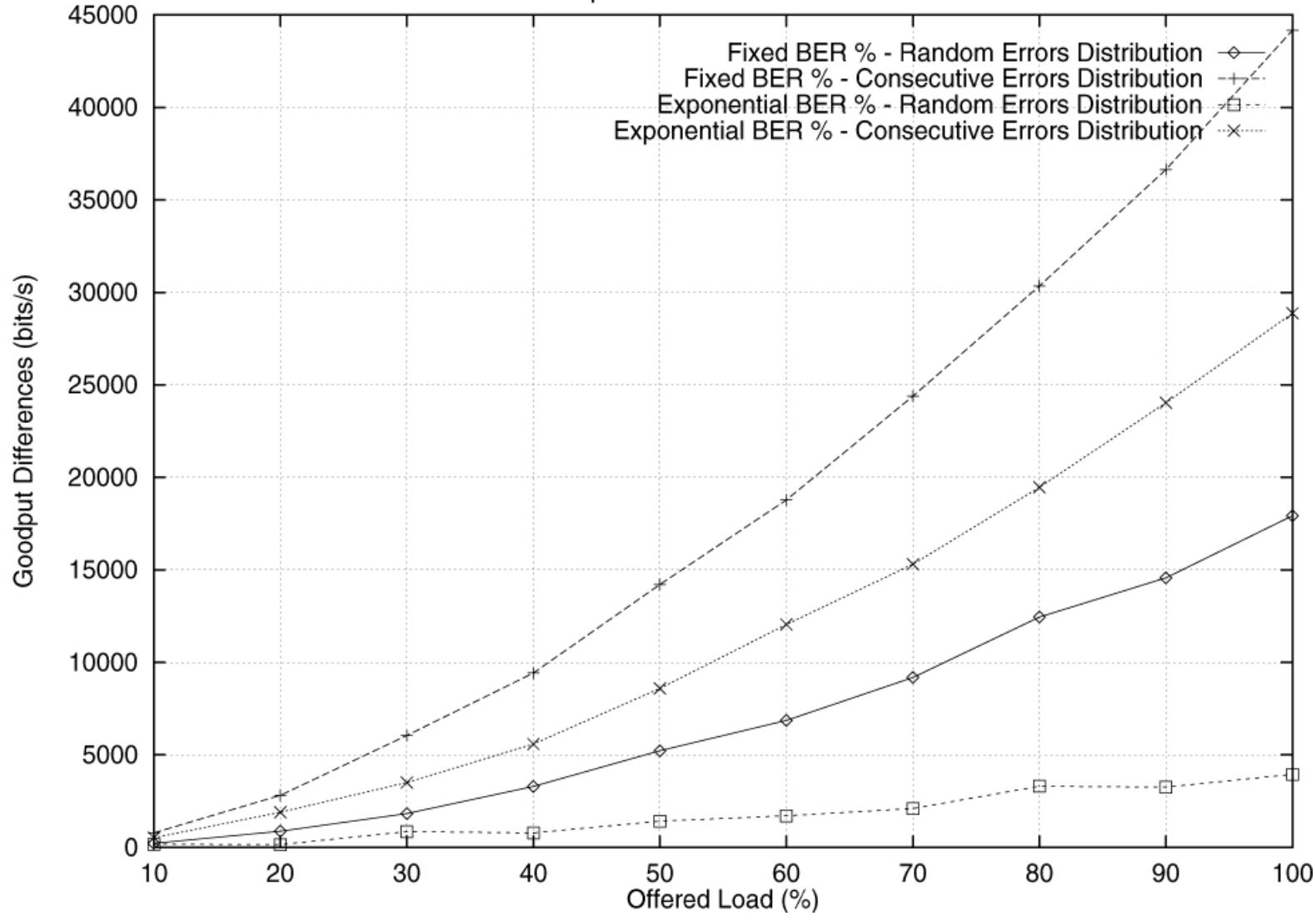
BER = 1% , Throughput

Experiment with BER = 1.0%



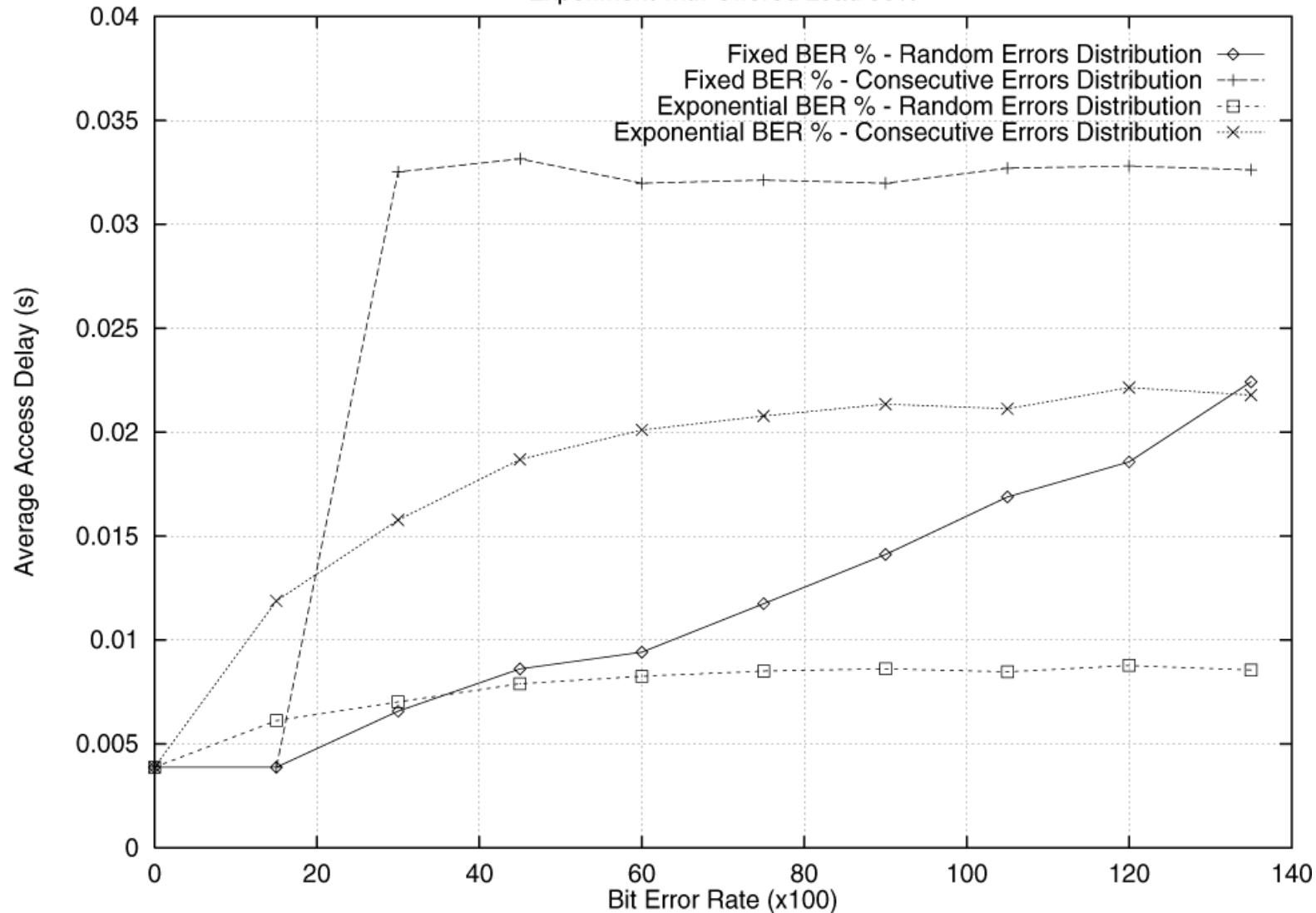
BER = 1%, Goodput

Experiment with BER = 1.0%



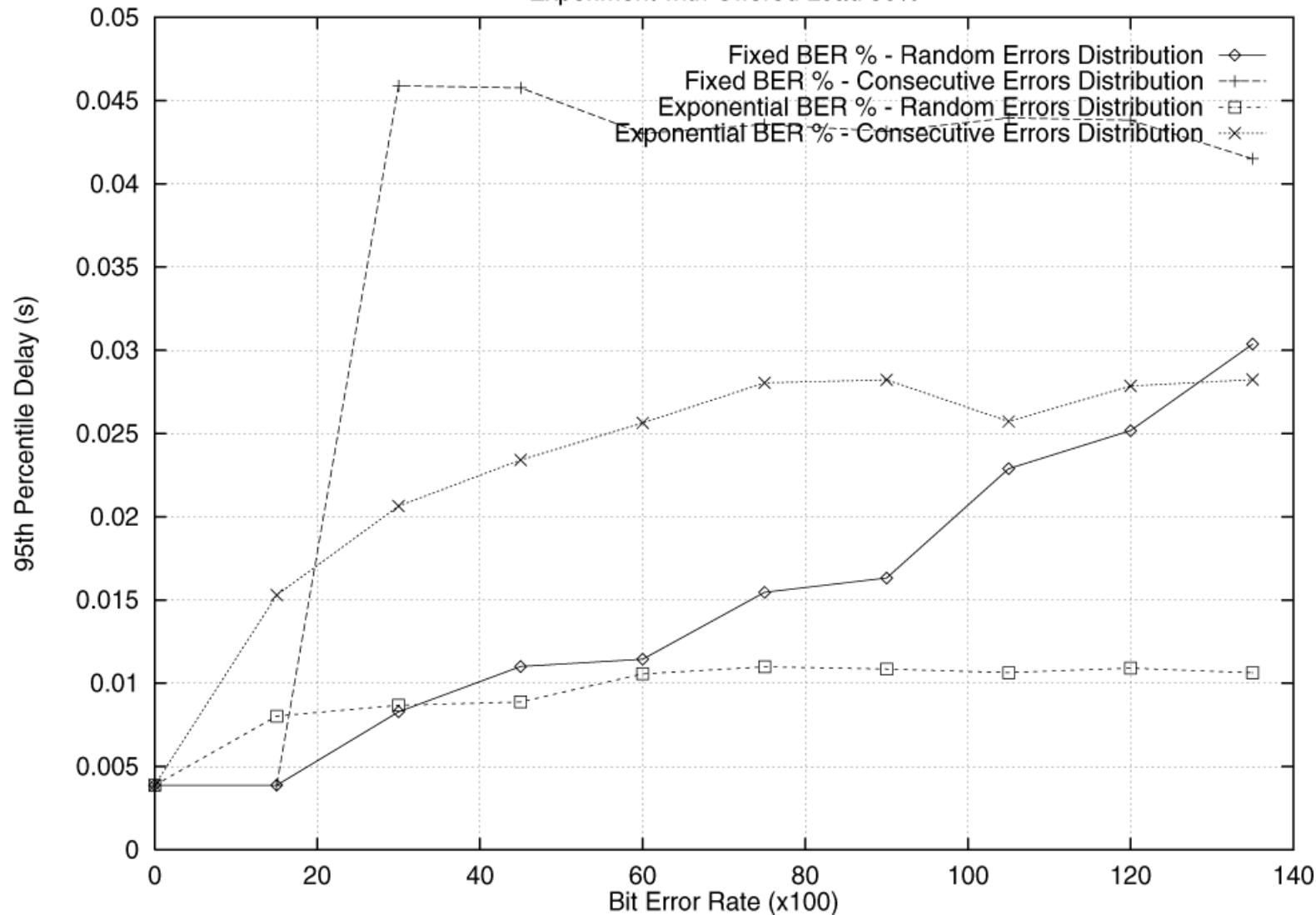
Load 50%, Average Delay

Experiment with Offered Load 50%



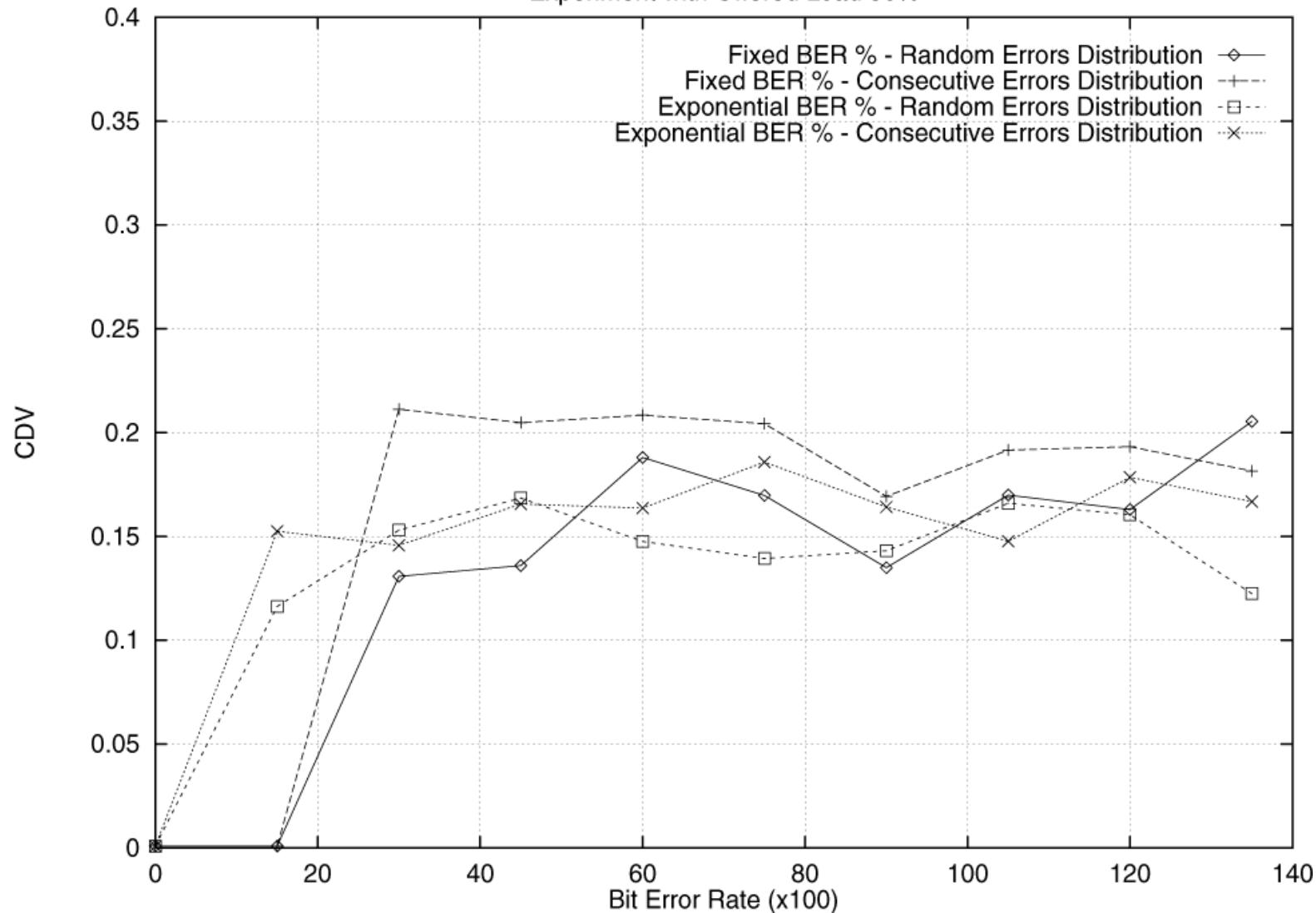
Load = 50% , Delay Percentiles

Experiment with Offered Load 50%



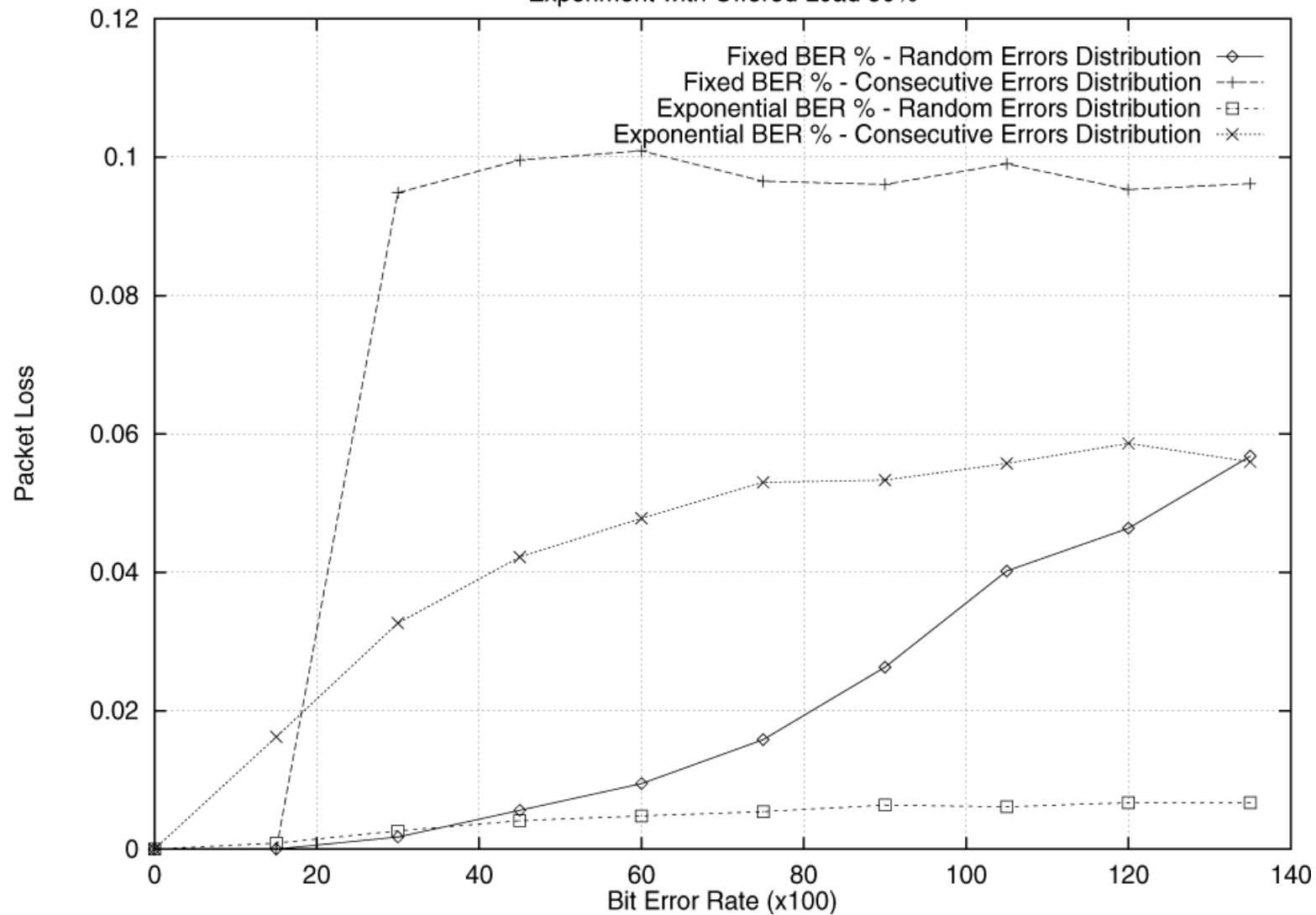
Load = 50%, Coefficient of Delay Variance

Experiment with Offered Load 50%



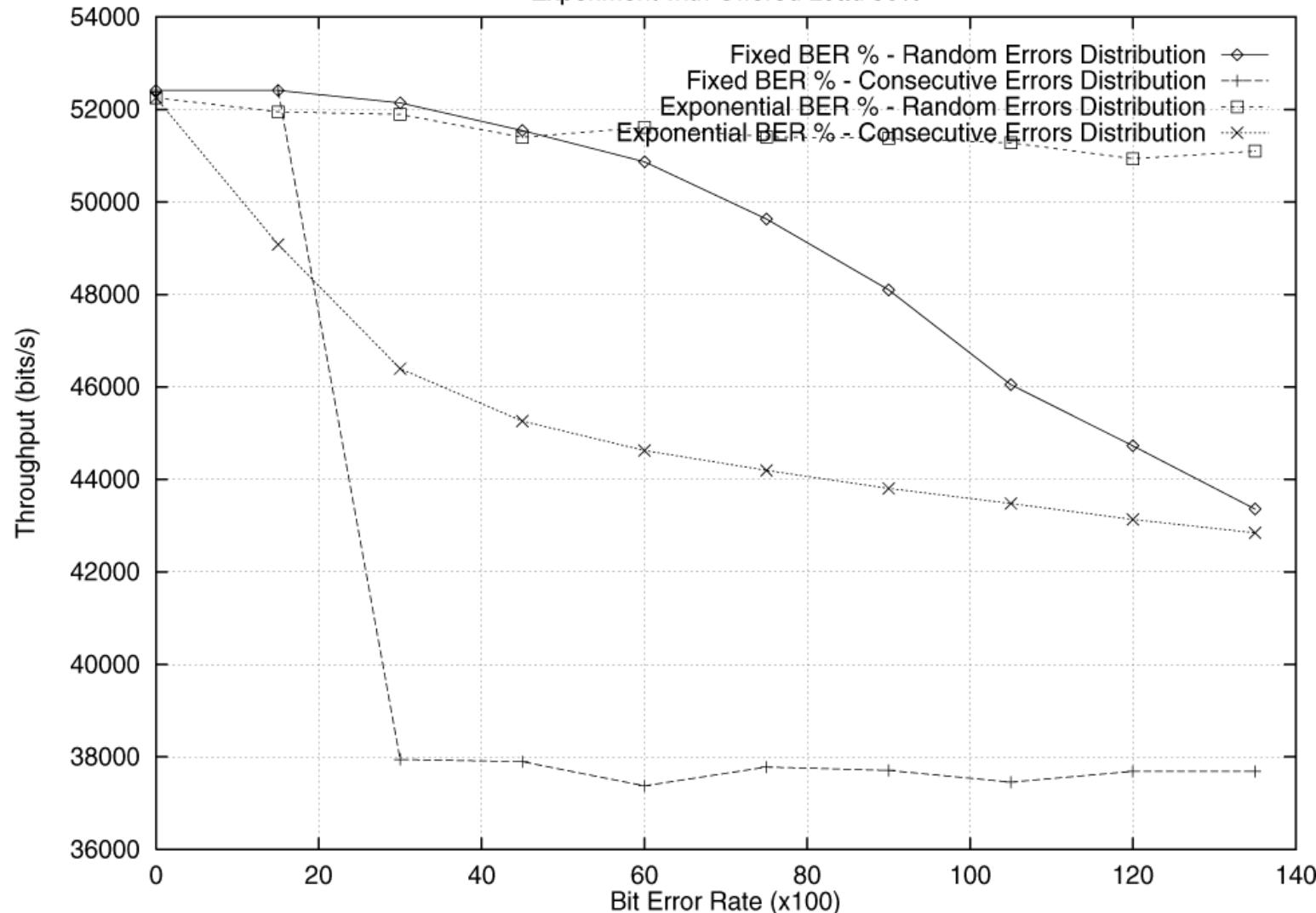
Load= 50% , Packet Loss

Experiment with Offered Load 50%



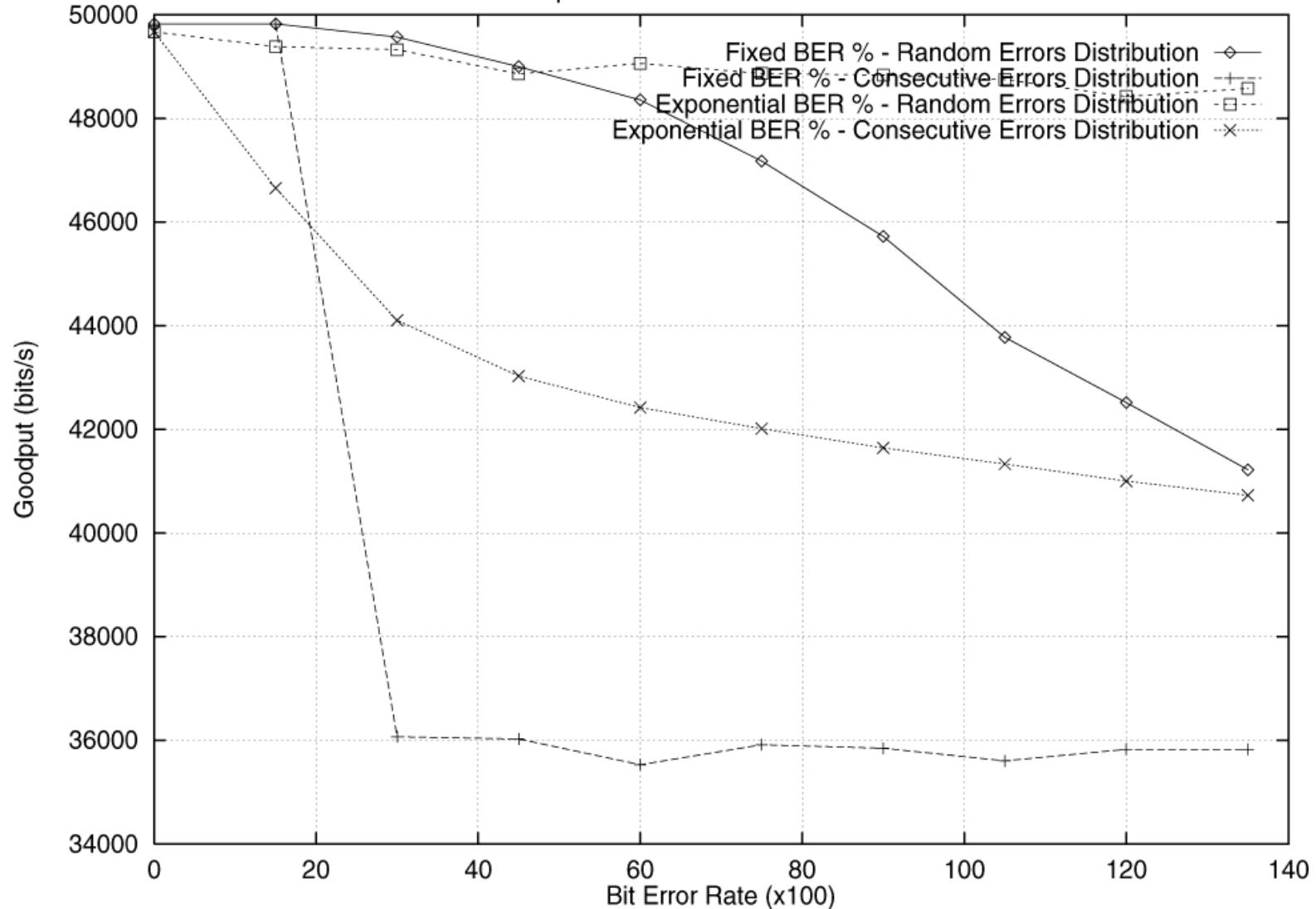
Load = 50% , Throughput

Experiment with Offered Load 50%



Load = 50%, Goodput

Experiment with Offered Load 50%



Summary

- Presented a status report on the BT MAC model development.
- Gave an example of BER modeling

Next Step

- More Results:
 - more experiments with different BER, loads, number of devices.
- Continue BT MAC model development:
 - SCO, master scheduler.
- Work on MAC/ PHY interface
 - BER modeling.